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The growth companies puzzle:
Can growth opportunities measures predict firm growth?

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Abstract

While numerous empirical studies include proxies for growth opportunities in their analyses, there is limited evidence as to the validity of the various growth proxies used. Based on a sample of 1,942 firm years for listed UK companies over the period 1990 to 2004, we assess the performance of eight growth opportunities measures. Our results show that while all the growth measures show some ability to predict growth in company sales, total assets or equity, there are substantial differences between the various models. In particular, Tobin's Q performs poorly while dividend based measures generally perform best. However, none of the measures has any success in predicting earnings per share growth, even when controlling for mean reversion and other time-series patterns in earnings. We term this the 'growth companies puzzle'. Growth companies do grow, but they do not grow in the key dimension (earnings) theory predicts. Whether the failure of 'growth companies' to deliver superior earnings growth is attributable to increased competition, poor investments, or behavioural biases, it is still a puzzle why growth companies on average fail to deliver superior earnings growth.

Keywords: Growth opportunities, growth proxies, firm growth.

JEL classification: G31

The Growth Companies Puzzle:

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1. Introduction

As recognised by Miller and Modigliani (1961), the value of the firm can be split into the value of assets in place and the value of growth opportunities. The value of these growth opportunities is the net present value of future investment projects. Growth opportunities may be a significant component of firm value, and since Miller and Modigliani's seminal paper, proxies for growth opportunities have been included in a wide variety of empirical finance studies. For example, prior studies have argued that the level of growth opportunities may influence the capital structure decision (e.g., Smith and Watts, 1992; Gaver and Gaver, 1993; Rajan and Zingales, 1995; Goyal *et al.*, 2002; Johnson, 2003; Dahlbor and Upneja, 2004; and Billett *et al.*, 2007), the stock market reaction to finance decisions (e.g., Pilotte, 1992; Denis, 1994; and Burton *et al.*, 1996 and 2000), the level of abnormal returns in mergers and acquisitions (e.g., Georgen and Renneboog, 2004), and also executive compensation (e.g., Smith and Watts, 1992).

However, as growth opportunities are not directly observable, studies have to rely on various indirect measures for the presence of growth opportunities. There is, however, limited agreement on how best to measure the level of growth opportunities, and a number of alternative measures for the presence of growth opportunities are frequently used in empirical studies, including market to book proxies (such as Tobin's *Q*), earnings proxies (the Earnings/Price ratio), and dividend proxies (the Dividend/Price ratio). As well as simple proxies, which merely purport to rank firms

according to their level of growth opportunities, there are also models (Kester, 1984; Brealey and Myers, 1991; Ottoo, 2000; and Hirst *et al.*; 2008) which are designed to quantify the value of a firm's growth opportunities. This paper will use eight different growth measures to identify which ones are most closely linked to subsequent firm growth.

Through the research design and the data-set, this paper makes a number of distinctive contributions to the literature. Firstly, we look at the performance of growth opportunities *models* as well as growth opportunity *proxies*. Secondly, reflecting the basic definition of growth companies, we focus on EPS as our measure of realised growth. However, we also analyse the ability of the various growth opportunities models to predict size growth, including growth in sales, total assets and equity. Thirdly, in addition to correlation analysis as commonly used in prior studies, including Kallapur and Trombley (1999), we extend the analysis to also control for mean reversion and other predictable patterns in earnings. This provides a cleaner analysis of the relationship between the level of growth opportunities and future realised earnings growth. As a fourth contribution of our paper, we offer some possible explanations for the inconsistent performance of growth opportunities models in predicting different dimensions of growth. Fifthly, we look at firm growth over a ten year period, which gives a longer perspective than most other studies (for example, Kallapur and Trombley use three and five years). Finally, we add UK evidence to a literature which has worked almost exclusively with American data.

2. Growth opportunities and earnings growth

Miller and Modigliani (1961) and the subsequent growth opportunities literature define growth as the ability to make future investments which give returns exceeding the cost of capital. How can such investment be measured? Company growth can be measured in several ways, including sales growth, growth in equity and growth in total assets. If a company invests, it is likely to grow in all these ways. However, this type of growth may have been achieved by investment in zero or even negative NPV projects¹, and it does not necessarily indicate that a company has exercised valuable growth opportunities. We suggest that growth in EPS is a more reliable indicator.

It is worth considering in some detail the relationship between the profitability of an investment and its impact on future earnings per share. Investment may require the issuance of new shares, but we assume that, if new shares are issued, they are issued at a price that gives the new shareholders zero-NPV cash flows. In other words, we make the conventional assumption that all the NPV from the project is captured by the existing shares. If the appropriate adjustment is made for share splits or consolidations, profitable projects will have a positive NPV from the incremental cash flow per existing share. Hence,

$$\sum_{t=0}^T ICF_t e^{-rt} > 0 \quad (1)$$

where ICF is the incremental cash flow from the project.

We now use the accounting relationship

$$\text{Cash Flow} = \text{Earnings} + \text{Depreciation} - \text{Investment}$$

This relationship operates in every year both for the company as a whole and on a per share basis. We are using ‘per share’ measures.

$$ICF_t = IE_t + ID_t - II_t \quad (2)$$

where IE refers to incremental earnings, ID to incremental depreciation, and II to incremental investment. All variables are measured on an incremental basis as a consequence of an investment made in $t=0$ which generates depreciation allowances in years $t=1 \dots T$. Taking present values over the life of the project,

$$\sum_{t=0}^T ICF_t e^{-rt} = \sum_{t=0}^T IE_t e^{-rt} + \sum_{t=1}^T ID_t e^{-rt} - II_0 \quad (3)$$

We also know that, over the project's life, aggregate depreciation matches the original investment, so that

$$II_0 = \sum_{t=0}^T ID_t > \sum_{t=0}^T ID_t e^{-rt} \quad (4)$$

and so that $\sum_{t=0}^T ID_t e^{-rt} - II_0$ is negative.

Using equation 3, the incremental effect of a profitable investment generates the following set of inequalities:

$$\sum_{t=0}^T IE_t > \sum_{t=0}^T IE_t e^{-rt} > \sum_{t=0}^T ICF_t e^{-rt} > 0$$

Profitable investments can therefore be expected to generate an aggregate increase in future earnings per share.

Note, however, that the converse is not necessarily true. It is possible for an unprofitable investment to generate positive expected aggregate earnings. This can arise

if the sum of $\sum_{t=0}^T IE(1 - e^{-rt})$ and $\sum_{t=1}^T ID(1 - e^{-rt})$ exceeds the negative NPV of the

underlying investment. It remains true, however, that increases in earnings per share are closely and logically related to the profitability of a company's investment projects. By

contrast, sales, assets and total equity will tend to grow when project NPV is negative as well as when it is positive.

While theory suggests the appropriate measure for whether companies deliver valuable growth is growth in earnings, such a measure is, however, subject to various measurement problems, including earnings volatility and potential earnings management. We return to these issues later in the paper. However, given the potential problems with earnings growth, which have been identified in the prior literature (e.g., Kallapur and Trombley, 1999), we also explore the relationship between the level of growth opportunities and other measures of firm growth – in particular, growth in sales, assets and equity. The objective of this paper is to investigate how successfully different growth opportunities measures perform when predicting future firm growth, and in particular, earnings growth. We shall calculate the relative predictive power of different growth opportunities measures, observe whether the more complex models perform better than simple proxies, and consider possible explanations for the patterns observed. The analysis will be based on a sample of 1,942 firm-years for UK listed companies over the period 1990 – 2004.

3. Growth opportunities as predictors of firm growth

There are a number of recent studies which have used growth opportunity measures as predictors of subsequent company growth. They can be classified according to the variables used to predict growth, the variables used to measure realised growth, and the data-set employed.

The literature has tended, in general, to use growth proxies rather than growth models, as predictors. The most widely used predictor is the book-to-market ratio².

The higher the ratio, it is argued, the larger the value of growth opportunities. The ratio appears in various forms, including equity book-to-market, asset book-to-market, and Tobin's Q .

A low earnings/price ratio is also taken to indicate the presence of growth opportunities³. The low earning yield today, it is argued, is justified because earnings will grow substantially in the future. Similarly, a low dividend/price ratio is also taken to indicate potential growth⁴.

We use all these three as proxies, as they play a central role in the literature⁵. We also use three models of growth opportunities (Kester/Brealey and Myers, 1984 and 1991; Hirst *et al.*, 2008; and Ottoo, 2000). These models will be explained in more detail in section 4 below.

The study by Kallapur and Trombley (1999) has an objective, similar to ours, of testing the link between various growth opportunities proxies (but not the growth opportunities measures used in this study) and subsequent company growth. They look at growth in the book values of equity. However, as a robustness test, they also analyse future sales, asset growth and earnings growth, although their discussion of these results is brief. Kallapur and Trombley note that their results are generally robust to measuring realised growth based on growth in sales or assets, but the association between the growth proxies and earnings growth is much weaker. They argue that the weak association between the growth opportunities proxies and earnings growth "...could be attributable to measurement problems such as the greater variability of earnings and the relatively high frequency of negative reported earnings". (p. 509). As we use earnings growth as our main measure of valuable firm growth, we will return to these measurement problems later in the paper.

In the next section we explain the growth proxies and models used for valuing growth opportunities used in this study.

4. Growth models

Growth models do not simply rank companies according to their growth prospects; they go further and offer an estimate of the proportions of company value accounted for by assets in place and growth opportunities, respectively. Kester (1984) and Brealey and Myers (1981, 1991⁶) develop similar models based on earnings for valuing assets in place (the KBM model), while Hirst *et al.* (2008) develop an alternative model based on dividends (the HDJ model). While numerous studies have used the relationship between book values and market values as a proxy for the level of growth opportunities, Ottoo (2000) takes this a step further to argue that the relationship can be used as a measure for the proportion of value accounted for by growth opportunities.

4.1. The Kester, Brealey and Myers model of growth opportunities

Kester (1984) and Brealey and Myers (1981) develop a simple model for decomposing the share price into the value of assets in place and the value of growth opportunities. Following Danbolt *et al.* (2002), we will henceforth refer to this as the Kester, Brealey and Myers, or the KBM, model.

Let P_s refer to the share price, P_a to the share value due to assets in place, and P_g to the element of share price due to growth opportunities: $P_s = P_a + P_g$. As argued by Miller and Modigliani (1961), the value of assets in place can be seen as the present value of the uniform perpetual earnings of assets currently held by the firm. In the

KBM model, the company's earnings per share (EPS), valued in perpetuity, are thus assumed to generate the value of the firm's assets in place.

We calculate the percentage of equity value accounted for by growth opportunities, according to the Kester-Brealey-Myers model, as⁷:

$$\% P_g \text{ KBM} = \frac{P_s - \frac{EPS}{K_s}}{P_s} * 100 \quad (5)$$

Limitations of the KBM model

The KBM model, valuing assets in place as a level perpetuity of earnings, is only applicable where earnings are positive. The value of growth opportunities is very sensitive to the number for EPS, which may be volatile. To avoid one-off company surprises that may affect earnings outcomes, both Kester (1984) and Brealey and Myers (1996) base their analyses on earnings forecasts. Following Brealey and Myers, we use the average of the earnings forecast for the current year and the subsequent year⁸.

As discussed by Danbolt *et al.* (2002) in their critical review of the KBM model, the model is also sensitive to the assumption regarding inflation. Brealey and Myers (2003) explicitly use a nominal risk free rate. However, if K_s is estimated using the traditional CAPM with a nominal risk free rate, there is an assumption that EPS will remain constant in *nominal* terms. Both Danbolt *et al.* (2002) and Wall (2007) question this assumption. As argued by Danbolt *et al.* (2002), "It seems difficult to justify an assumption that the real EPS of UK corporations should decline at exactly the same rate as the purchasing power of the British pound". (p. 205). Therefore, following Danbolt *et al.* (2002) and Wall (2007), we also estimate the KBM model assuming forecast earnings remain constant in *real* terms.

The real KBM model

The KBM_{real} model uses a real rather than a nominal cost of equity capital (K_{sr}) for estimating the value of assets in place, and the percentage of value accounted for by growth opportunities is in this case estimated as follows⁹:

$$\% P_g KBM_{real} = \frac{P_s - \frac{EPS}{K_{sr}}}{P_s} * 100 \quad (6)$$

The traditional KBM model, by discounting EPS at a nominal rather than a real cost of capital, will tend to overestimate the value of growth opportunities. Wall (2007) notes that the overestimation will be particularly pronounced for low-growth firms. Note that the KBM model (in both nominal and real forms) will generate negative values for growth opportunities in many cases. However, the theoretical literature on ‘negative growth’ is sparse, and it is not clear that the model is appropriate in these cases¹⁰. We shall return later to the problems posed by this issue.

While KBM_{real} adjusts for the effect of inflation, the model may still apply an inappropriate cost of capital. As recognised by Myers and Turnbull (1977), the systematic risk of companies’ growth options may differ from the systematic risk of its real assets. Investors may therefore expect a different rate of return on growth opportunities than on assets in place. However, despite this insight, Brealey and Myers use the overall equity beta for estimating the present value of assets in place. If growth options have a higher level of systematic risk than the underlying assets in place, the beta for assets in place (and therefore the cost of capital for assets in place) should be less than the beta (and cost of capital) of equity. The KBM model – even when adjusted for inflation – may therefore apply too high a discount rate for the estimation of the

value of assets in place¹¹, and thus overestimate the value of growth opportunities. The problem of distinct ‘asset betas’ and ‘growth betas’ is recognised in the next model.

4.2. The Hirst, Danbolt and Jones model of growth opportunities

Hirst *et al.* (2008) develop an alternative model for valuing growth opportunities. The Hirst, Danbolt and Jones (HDJ) model estimates the value of assets in place based on dividends rather than current (or forecast) earnings. See Hirst *et al.* (2008) for the derivation of their model from Gordon’s (1959) growth model. Using the HDJ model, we estimate the percentage of firm value accounted for by growth opportunities as follows¹²:

$$\%P_g \text{ HDJ} = \frac{P_s - \frac{D_0(1+g) + E * g}{K_{ar}}}{P_s} * 100 \quad (7)$$

Limitations of the HDJ model

The HDJ model has a unique feature in that it generates distinct beta values for both assets-in-place and growth opportunities. However, it also has significant limitations. By valuing assets in place based on capitalised dividends, the HDJ model is only applicable to companies paying dividends. While the majority of companies – at least in the UK¹³ – pay substantial dividends, a number of firms do not. Furthermore, if high growth companies are the ones least likely to pay dividends, the application of the HDJ model may be skewed towards companies with lower levels of growth opportunities.

The HDJ model is similarly not applicable for companies with negative or zero book value, or where book value of equity exceeds the share price. Finally, the HDJ

model can also generate negative values for growth opportunities. Since the model is very specifically based on company expansion, and expansion and contraction are not necessarily symmetric processes, Hirst *et al.* (2008) argue that these negative values should have no other interpretation than to indicate the absence of growth opportunities. We follow Hirst *et al.* (2008) and restrict the analysis to cases where the estimated value of growth opportunities based on the HDJ measure is positive.

4.3. The Ottoo Excess Market Value models

Several prior studies have used the market-to-book ratio as a proxy for the presence of growth opportunities. If book values proxy for the value of assets in place, then, as Johnson (2003, p. 232) argues, “If the market recognizes the value of firms’ growth opportunities, the firms with these opportunities should have market-to-book ratios that exceed one...”. Using the same argument, Ottoo (2000) derives the Excess Value of the Firm (EVF) and Excess Value of Equity (EVE) models for estimating the value of growth opportunities, based on the extent to which the market-to-book value of assets, or the market-to-book value of equity, respectively, exceeds one.

Following Ottoo (2000), we estimate the percentage of value attributable to growth opportunities based on the excess value models as follows¹⁴:

$$\%P_g \text{ EVF} = \frac{(MV \text{ Equity} + BV \text{ Debt}) - (BV \text{ Equity} + BV \text{ Debt})}{(MV \text{ Equity} + BV \text{ Debt})} * 100 \quad (8)$$

$$\%P_g \text{ EVE} = \frac{MV \text{ Equity} - BV \text{ Equity}}{MV \text{ Equity}} * 100 \quad (9)$$

Limitations of the EVF and EVE models

While the market-to-book value, of which the EVF and EVE models are

derivatives, is probably the most commonly used proxy for the presence of growth opportunities, these measures are not without limitations.

Excess Value of Equity cannot be meaningfully calculated if the book value of equity is zero or negative. While the Excess Value of the Firm can technically still be calculated with negative book equity – provided the company has a positive value of debt, which exceeds the negative book value of equity, so that the denominator in equation 8 remains positive – a negative book value is arguably unlikely to be an appropriate proxy for the value of assets in place.

However, even for positive values, the book value of equity is arguably an inappropriate estimate of the value of assets in place. If the company's current operations are the result of positive NPV investments, the market value of these operations will (at least under historic cost) exceed the book value of these projects by the NPV of future excess earnings. Thus, while EVF and EVE may *proxy* for the presence of growth opportunities, they are likely to underestimate the value of assets in place, and consequently overestimate the proportion of value attributable to growth opportunities.

4.4. Proxies for the level of growth opportunities

In addition to the three measures of growth opportunities outlined above, we also use three proxies for the presence of growth opportunities. These proxies are all widely used in the literature, as discussed above. The detailed descriptions of our proxies are as follows:

Tobin's Q

Tobin (1969) defined Q as the ratio between the market value of assets and the estimated replacement cost. However, due to the difficulties in estimating replacement costs, we use a simple market-to-book ratio approximation of Q :

$$Q = \left(\frac{\text{Total assets} + \text{MV equity} - \text{BV equity}}{\text{Total assets}} \right) \quad (10)$$

It should be noted that our equation for Q is similar to that of the calculation of EVF above. However, while EVE is calculated using book value of debt calculated as the sum of Loans and Short-term debt, total assets also includes other liabilities such as trade credit. Still, we would expect Q and EVF to be highly correlated.

Earnings/Price Ratio

An alternative proxy for growth opportunities is the earnings/price ratio¹⁵, calculated as follows:

$$\%EP = \frac{EPS}{P_s} * 100 \quad (11)$$

If investors are expecting significant growth in earnings, they will be willing to pay a high multiple of current earnings. Thus, a low EP ratio may be taken as a proxy for the market's expectations of future valuable growth.

The KBM model is closely linked to the inverse of the EP ratio. While both models are based on the relationship between the share price and earnings, the KBM model uses the company's cost of capital in capitalising earnings. As such, the KBM model allows for differences in risk (as captured by β_s in CAPM) when estimating the value of assets in place. By using forecast rather than realised earnings, the KBM model may also avoid the effect of one-off earnings surprises¹⁶. Still, we would expect the ranking of companies based on their estimated level of growth opportunities to be

similar (with negative correlation) whether we undertake the analysis using the KBM measure or the EP ratio.

Dividends/Price Ratio

Growth companies may be expected to pay low dividends, retaining a high proportion of earnings for investment. Thus, an alternative to the dividend-based HDJ model of growth opportunities is the simple dividends to price ratio (the dividend yield), calculated as follows:

$$\%DP = \frac{D_0}{P_s} * 100 \quad (12)$$

We take a low DP ratio to be a proxy for high levels of growth opportunities. While there are significant differences between the DP and the HDJ model (not least the use of the risk-adjusted real cost of capital for assets in place in the HDJ model), we expect high negative correlation between the DP and HDJ measures of growth opportunities.

5. The data set

Our analysis of the proxies and measures for the level of growth opportunities is based on data for the UK Financial Times All-Share constituent companies over the period from January 1990 to December 2004¹⁷. We start with an initial sample of 6,163 firm-years for which we are able to obtain (from *Datastream*) the core accounting and market data required to calculate at least one of the growth opportunities measures.

As can be seen from Table 1, it is not possible to calculate the growth opportunities proxies for all the 6,163 cases in our data set. The calculations fail either because necessary data is missing or because the data has a numerical value that makes

it impossible to complete the calculation meaningfully. Since the different measures and proxies require different data, the number of useable cases that can be derived from our data set varies greatly between the different measures and proxies, ranging from 3,769 firm-years for HDJ to 5,970 firm-years for Q . To reduce the influence of outliers, we also trim the top and bottom 2.5% of each distribution. In addition, as HDJ explicitly argue that their model is not appropriate for companies with negative growth opportunities, this brings the maximum sample for analysis based on this measure down to 2,515 firm-years. We are able to estimate all eight measures and proxies for a balanced sample of 1,942 firm-years.

Table 1 about here

5.1. Data characteristics: The level of growth opportunities

Descriptive statistics for the growth opportunities measures and proxies are contained in Table 2. It should be noted that even though we have trimmed the top and bottom 2.5% of the distribution of each of the growth opportunities proxies, some large negative values remain. Thus, while the traditional KBM model suggests growth opportunities on average account for approximately 38% of firm value, the median is four percentage points higher, at 42%.

As discussed in section 4.1, by applying a nominal cost of capital, the KBM model may overestimate the value of growth opportunities. Applying a real cost of capital, we estimate the mean proportion of firm value accounted for by growth opportunities to be in the region of 12%. The HDJ model also applies a real cost of capital, but is based on dividends rather than earnings, and also adjusts the beta for the presence of growth opportunities. The HDJ model suggests growth opportunities, on

average, account for about 30% of firm value.

Otto's EVF and EVE market-to-book ratio models, suggest growth opportunities on average account for 60% and 71% of firm value, respectively. However, as discussed in section 4.3, by effectively assuming all current projects were zero NPV investments, EVE and EVF may overestimate the value of growth opportunities.

While the remaining variables may proxy for the level of growth opportunities, they do not give estimates of the proportion of value accounted for by growth opportunities. We obtain a mean Q ratio of 2.03, while the EP ratio averages 6.85% and the DP 2.93%.

Table 2 about here

The different measures and proxies clearly produce different estimates for the *level* of growth opportunities. However, do they identify the same companies as having either high or low levels of growth opportunities? We explore this next, by analysing the correlations between the various proxies for the level of growth opportunities.

5.2. Data characteristics: Correlations between growth measures

The correlation matrix between the various growth opportunities proxies is provided in Table 3. Note that we would expect positive correlations between all measures except between the other growth proxies and either EP or DP, which have lower values for growth companies. All the growth measures are significantly correlated, with the predicted sign, with the exception of the correlation between EVE and DP, which is not significant¹⁸.

However, the correlation coefficients vary substantially between the various

measures for the level of growth opportunities. While the levels of growth opportunities based on the KBM and KBM_{real} models are very different, these measures of growth opportunities are, as one would expect, highly correlated (correlation coefficient of 0.98). However, the correlations between KBM and the other proxies, while significant, are fairly low. The correlation with the other earnings based measure, EP, is -0.55, while the next highest correlation is with HDJ, at 0.29.

The dividend-based HDJ model is, as one would expect, significantly correlated with the DP, although the correlation coefficient (at -0.55) suggests these models are not perfect substitutes. Somewhat surprisingly, the HDJ model is also significantly correlated with the market-to-book based proxies of EVF, EVE and Q, with correlation coefficients between 0.58 and 0.78. The various market-to-book based proxies are, as one would expect, highly correlated, with correlation coefficients between 0.56 and 0.81.

Overall, while the various proxies and measures for the level of growth opportunities are significantly correlated, the correlation coefficients are far from unity. The proxies and measures are therefore unlikely to be perfect substitutes. This raises an important question: Which proxy is most closely related to future firm growth? We explore this question next.

Table 3 about here

6. The measurement of firm growth

In their study of the relationship between investment opportunities and realised growth, Kallapur and Trombley (1999) focused on the percentage growth in the book value of equity over the following three or five years. Their results were found to be

similar using growth in sales or total assets, although “...the associations were much weaker for earnings growth”. (p. 509). We will similarly study the relationship between the level of growth opportunities and subsequent firm growth, including all four measures of firm growth, and extending the analysis to a ten year forecast horizon.

In choosing the growth in equity as their preferred growth measure, Kallapur and Trombley argue that the measure is consistent with the Ohlson (1995) model “...in which firm value arises from the firm’s ability to earn above normal returns on book value.” (p. 508). They acknowledge that the measure may be affected by mergers and acquisition activity, but argue that this is a relatively minor issue in their sample of US companies, as stock financed acquisitions were relatively uncommon.

Analysis based on growth in equity book values is arguably more problematic in the UK where share financed acquisitions are more common¹⁹, and where a considerable proportion of companies have negative or small book values²⁰. Mergers and acquisitions may therefore have a larger impact on book values in the UK. Still, to allow for a comparison with prior literature, we include growth in the book value of equity, as well as growth in sales and total assets, in our analysis²¹.

As discussed in section 2, we believe the theoretically most appropriate measure of valuable growth is growth in EPS. This variable has been chosen because it most clearly identifies firms which have undertaken valuable, positive NPV, investment projects.

To avoid spurious correlation with the earnings-based growth proxy (which incorporates EPS_0), we calculate the base level of earnings from which we estimate future earnings growth as the average of earnings for the years $t-1$ and $t+1$:

$$EPS_{-1+1} = (EPS_{-1} + EPS_{+1}) / 2 \quad (13)$$

As one-off company surprises may affect earnings outcomes, we calculate realised future earnings as three-year averages of earnings centred 3 and 5 years into the future, as follows:

$$EPS_{+2+4} = \left(\sum_{+2}^{+4} EPS \right) / 3 \quad (14)$$

$$EPS_{+4+6} = \left(\sum_{+4}^{+6} EPS \right) / 3 \quad (15)$$

We also analyse longer term earnings growth, based on the ten year average of earnings from year 2 to year 11:

$$EPS_{+2+11} = \left(\sum_{+2}^{+11} EPS \right) / 10 \quad (16)$$

We measure earnings growth scaled by Total (Book) Assets per share (TAS) at time zero. Growth in earnings from time zero (the average of years -1 and +1) to year three (the average of years 2, 3 and 4) is thus calculated as:

$$EPS\ Growth_{+2+4} = \frac{EPS_{+2+4} - EPS_{-1+1}}{TAS_0} \quad (17)$$

with growth for the other time periods calculated similarly²².

We recognise that there will be significant errors in the measurement of both the numerator and the denominator of the EPS growth variables. Given the purpose for which we are using them, the accounting measures of earnings and assets may have substantial deficiencies. One concern is that managers may engage in earnings management, e.g., through the use of discretionary accruals (Jones, 1991; Dechow *et al.* 1995). Such earnings management may distort reported earnings in any one year (with accruals used to shift earnings between time periods). To overcome some of the problems of potential earnings management, as well as to smooth out any transitory

shocks to earnings, we average earnings over a number of years. However, we acknowledge that there are limitations to basing the analysis on earnings growth, in that average earnings will vary over time due to booms and recessions²³, and earnings may also change over time due to mean reversion or other factors unrelated to the exercise of growth opportunities. We return to this in section 9 below.

In a similar way to earnings growth, we also calculate three year growth in sales, assets and book equity as the change from the average for years -1 and +1, to the average of years 2, 3 and 4. We scale the variables by sales, total assets or equity at time zero. We define each of these variables by the following equations:

$$Sales\ Growth_{+2+4} = \frac{Sales_{+2+4} - Sales_{-1+1}}{Sales_0} \quad (18)$$

$$Total\ Assets\ Growth_{+2+4} = \frac{Total\ Assets_{+2+4} - Total\ Assets_{-1+1}}{Total\ Assets_0} \quad (19)$$

$$Equity\ Growth_{+2+4} = \frac{Equity_{+2+4} - Equity_{-1+1}}{Equity_0} \quad (20)$$

Longer-term growth, $Grow_{+4+6}$ and $Grow_{+2+11}$, are calculated similarly.

7. Ex-post firms growth

We next consider the extent to which our sample companies grow. Descriptive statistics for realised firm growth over the three periods – $Grow_{+2+4}$, $Grow_{+4+6}$ and $Grow_{+2+11}$, are presented in Table 4.

Table 4 about here

On average, turnover of our sample firms increased by 46% over a three year period ($Growth_{+2+4}$), rising to 84% growth over five years ($Grow_{+4+6}$) and 131% over a ten year period ($Grow_{+2+11}$). Total assets and book equity, however, grew even faster,

with total assets and equity on average both growing by 55% over the three year period, rising to 168% for total assets and 153% for equity over the ten year period. Although all variables have been trimmed at the 2.5% level, some skewness remains, with mean growth rates higher than the median.

With regard to earnings growth, the EPS of our sample companies on average grew by 1.18% of initial total assets over a three year period, rising to 1.50% for five year, and 2.27% for ten year earnings growth.

Table 5 contains the correlation coefficients between all the different measures of growth. All are highly significantly related. The three measures of size growth are also strongly linked, with correlation coefficients between 0.58 and 0.87. The relationships between earnings growth and size growth measures are, however, notably weaker, with correlation coefficients only in the region of 0.18 to 0.28.

Table 5 about here

8. Growth opportunities and firm growth

We now turn to our main research question: To what extent are the various measures and proxies for the level of growth opportunities able to predict future firm growth? We start by analysing the relationship between the level of growth opportunities and size growth. The results for sales growth, total assets growth, and equity growth are reported in the first three sections of Table 6. Pearson correlations are shown, but the Spearman numbers give a similar picture. Cells which are shaded indicate that the correlation coefficient is significant and of the predicted sign. For growth in total assets, *all* of the correlation coefficients are significant, while for the sales growth and equity growth the results are somewhat more mixed. If growth

measures are most successful at predicting future investment, this result would be expected. Investment definitely increases assets, need not increase equity (if debt finance is used), or sales (if the project is cost-saving). The correlation coefficients for all growth opportunity measures and for all time periods have the right sign although not all of them are statistically significant. Indeed, there are significant differences in the level of the correlation coefficients.

Table 6 about here

The two KBM measures have very similar levels of performance. Adjusting for inflation does not appear to improve the outcome. Both KBM measures rank near the middle of the league table in predicting size growth. The two Excess Value models also give very similar performances. They are equally poor and rank near the bottom of the league. Indeed, the only measure that is worse is Tobin's Q . Q is very widely used in the literature to identify growth companies, but its use in this context seems to be a mistake. In our data set, Q performs badly in predicting our three size growth variables, where alternative growth predictors do much better.

The EP measure performs relatively well, but the best predictors of size growth turn out to be the dividend-based measures DP and HDJ. There are nine sets of correlation coefficients, combining the three different size measures with the three different time periods. HDJ is the 'winner' for five of these sets (in the sense that it has the highest correlation coefficient with subsequent realised growth), and DP is the 'winner' for four. It seems that dividends are the strongest basic source of information about future company size growth. Even then, the correlations with future growth are relatively low.

Our results for the UK with regard to the relationship between the level of

growth opportunities and size growth are somewhat different to those for the US reported by Kallapur and Trombley (1999). In particular, while they found the market-to-book ratio to be the best growth proxy, our results suggest dividend-based proxies perform better for UK companies. However, consistent with Kallapur and Trombley, we find simpler proxies to be as effective as the more complex measures.

The correlations between our measures of growth opportunities and subsequent earnings growth over the three different time periods are reported in the final section of Table 6. The results are very different to those for size growth. Indeed, growth opportunity measures have very little if any link to subsequent realised earnings growth. Over the shortest of our three periods, there is no significant correlation between any of our growth opportunity measures and subsequent growth. For our middle period, the relationship with HDJ is significant at the 5% level and with EVE at the 1% level. However, in both cases the sign of the relationship is opposite to the prediction. HDJ and EVE predict lower growth, not higher growth. Over the longest of our three periods, HDJ and EVE continue to have the wrong sign and other measures are insignificant with the exception of EP and DP. Both these variables are significant (at the 5% and 1% level, respectively) and have the predicted sign. Over the longer term, these simple proxies seem to be the best, indeed the only, measures capable of predicting earnings growth. Tobin's Q , which, with the other market-to-book measures is the most widely used proxy for growth opportunities, proves to be entirely insignificant over all three time periods²⁴. There is support in the literature for this result. For example, while Kallapur and Trombley (1999) found the MTB of assets to be the best proxy for predicting future growth in book values, they found the association to be much weaker for earnings growth.

With the partial exception of EP and DP, the outcome of our analysis is that growth opportunity measures don't predict earnings growth. While only Pearson correlations have been reported here, Spearman correlation gives a very similar picture.

While growth companies do grow, they do not appear to grow in the key dimension – earnings – which theory predicts. We term this the 'growth companies puzzle'.

However, our analysis so far – focusing on univariate correlations – is somewhat simplistic. Such analysis fails to take into account known patterns in earnings, such as mean reversion. We next explore whether the level of growth opportunities have any *incremental* impact on earnings growth.

9. Predicting Earnings Growth

Earnings are measured with a degree of error, and these errors may have an impact on estimated growth rates. In addition, our analysis has so far not taken into account other factors identified in the literature as associated with future earnings growth. We consider these next.

Firstly, if current earnings from which we measure earnings growth are overstated, future earnings growth will be low, and *vice versa*. Return on equity (ROE) may therefore be mean reverting. Indeed, both Fama and French (2000), using US data, and Allen and Salim (2005), using UK data, have found strong evidence of mean reversion in the ratio of earnings (before interest and tax) to total assets. In the US, a simple partial adjustment model gives an estimated rate of mean reversion of 38% per year, while for the UK data, the rate is 25%. Freeman *et al.* (1982), and Nissim and Ziv (2001) similarly find that ROE tends to be mean reverting. While our approach of

averaging both the base level of earnings (EPS_{-1+1}) and future earnings (EPS_{+2+4} , EPS_{+4+6} and EPS_{+2+11}) over a number of years should overcome at least some of these estimation problems from temporary volatility in earnings, we follow Nissim and Ziv and include lagged return on equity (ROE_{-1}) in a multiple regression analysis of earnings growth:

$$ROE_{-1} = EPS_{-1}/EQ_{-1} \quad (21)$$

where EQ is the book value of equity per share. We would expect companies with high ROE to encounter lower future earnings growth.

Secondly, highly profitable companies may be expected to attract other companies into the market, leading to increased competition and falling profit margins (Fama and French, 2007a and b). Similarly, low profits will tend to rise as competitors and capacity exit. This can also be expected to result in mean reversion in ROE.

Thirdly, while earnings may be mean reverting, there may also be some persistence in earnings growth rates, for example, if it takes time for competitors to enter the market or expand. Following Nissim and Ziv (2001) in their study of earnings growth, we therefore also include recent earnings growth (ΔEPS_0) as an additional control variable, defined as follows:

$$\Delta EPS_0 = (EPS_0 - EPS_{-1})/TAS_{-1} \quad (22)$$

where TAS refers to total assets per share.

Fourthly, Nissim and Ziv (2001) also argue that dividend changes contain significant information about companies' future earnings. As their evidence "...suggest that the relation between dividend changes and earnings changes is not symmetric for dividend increases and decreases..." (p. 2120), we follow Nissim and Ziv and allow for

different effects for dividend increases and decreases. We interact a dividend change variable (ΔDIV_0) with dummy variables for whether dividend changes are positive (DPC_0) or negative (DNC_0). The dividend change variable is defined as follows:

$$\Delta DIV_0 = (DIV_0 - DIV_{-1}) / DIV_{-1} \quad (23)$$

DPC_0 is a dummy variable taking the value 1 where dividend changes are positive ($DIV_0 \geq DIV_{-1}$), while DNC_0 is a dummy variable taking the value 1 where dividend changes are negative ($DIV_0 < DIV_{-1}$).

Fifthly, Cooper *et al* (2008) find asset growth rates to be strong predictors of future abnormal returns. While our study focuses on future earnings growth rather than future (abnormal) stock returns, we follow their approach and include a control for asset growth (ΔTA_0) in our regressions, calculated as:

$$\Delta TA_0 = (TAS_0 - TAS_{-1}) / TAS_{-1} \quad (24)$$

Finally, we control for company size. Cooper *et al* (2008) find the relationship between asset growth and future share returns to vary somewhat with firm size. Growth rates may also vary with firm size. We use the natural logarithm of the market value of the firm (in million pounds Sterling) as our proxy for firm size ($\ln MV_0$).

To test whether growth opportunities (GO_0), estimated using our eight measures and proxies, are significantly related to firm growth, once we control for the other firm characteristics potentially related to earnings growth, as discussed above, we run multiple regressions, as specified in equation 25:

$$\begin{aligned} EPS\ Grow = & \alpha + \beta_1 GO_0 + \beta_2 ROE_{-1} + \beta_3 \Delta EPS_0 + \beta_4 \Delta DIV_0 * DPC_0 + \dots \\ & \beta_5 \Delta DIV_0 * DNC_0 + \beta_6 \Delta TA_0 + \beta_7 \ln MV_0 + \varepsilon \end{aligned} \quad (25)$$

EPS Grow refers to the realised earnings growth (as specified in equation 17). We run regressions for 3, 5 and 10 year earnings growth. The variables are as defined above, and ε is the error term.

The regression output is reported in Table 7. We find a consistent negative relationship between firm size and future earnings growth, and consistent persistence in earnings growth, with high earnings growth for companies which have in the past experienced high growth rates. Note, however, that while the coefficients on ROE are negative (consistent with mean reversion in earnings), the regression coefficients are not significant²⁵. Similarly, the coefficients on dividend changes are generally not significant. Companies with high current growth rates in total assets experience lower rates of medium term earnings growth, although the coefficients are not significant for either the three year or the ten year forecast horizon.

Table 7 about here

Overall, our models are able to explain a significant proportion of the cross-sectional variation in earnings growth rates, with the adjusted R^2 of our regression models around 8%, 6% and up to almost 12% for the three, five, and ten year horizons, respectively.

However, a striking result is the general lack of significance of the coefficients relating to growth opportunities. With the exception of the coefficients on the EP ratio – which are significant for the three and ten year periods (but with small coefficients) and not significant for the five year horizon – none of the other measures of growth opportunities have a significant relationship with future earnings growth, or the coefficients have the opposite sign to what theory would predict.

10. The Growth Companies Puzzle

As discussed in the previous section, whether we focus on univariate correlations or whether we control for variables known to affect earnings, none of the measures used in the literature to identify growth companies actually succeeds in picking out companies which will grow their earnings – the key variable which enhances investment value. The ‘growth companies puzzle’ remains even when we control for more complex earnings patterns.

Kallapur and Trombley (1999), using US data, a different set of growth opportunity measures, and correlation rather than multiple regression analysis, report similar results. However, they suggest that their results are due to measurement errors, the variability of earnings and the removal of companies with negative earnings from the data set.

We, too, have had to remove negative-earnings cases from our data set, but there is no reason to believe that this damages the validity of our results. 16% of the cases in our original data set have earnings that are negative, zero, or missing for time zero. There is no theoretical reason to suggest that growth opportunity measures should not work successfully for the remaining sub-set of positive-earnings companies. Earnings are surely measured with an error, and after removing the cases with negative earnings, the remaining data set will, on average, have positive earnings residuals. Measurement of subsequent earnings growth from this base will therefore, on average, understate the underlying level of growth in company earnings. However, we would still expect to find that growth opportunities measures had power to distinguish companies according to the rate at which their future earnings will grow.

We suggest that the ‘growth companies puzzle’ is a genuine phenomenon, not a

statistical mirage. The variety of our own tests, the size of our data set and the fact that our results are consistent with earlier work, all suggest that the ‘growth companies puzzle’ is a genuine relationship that needs to be investigated and, if possible, explained.

11. Analysis

Our empirical results pose an obvious paradox. Why don't growth companies grow their earnings? The ‘growth company’, possessing positive NPV investment opportunities, has played a prominent part in the valuation literature from Miller and Modigliani (1961) onwards. Is it possible to identify such companies in the real world? None of the eight measures used in this paper succeeded in predicting earnings growth, and ours is not the only study to have observed the same absence of a relationship.

In the light of the results reported above, Kallapur and Trombley's explanation that this may be difficulties in measuring earnings is, in our view, inadequate. This paper has employed a sizeable data set and used a number of measures of earnings, all of which are averaged over several years. The results should be robust even if earnings are measured with significant errors.

Growth opportunity measures, or at least some of them, do predict company growth in terms of sales, assets and equity. Growth companies are investing and selling more, but this does not seem to be associated with a rise in EPS.

One possibility is that investment is being misdirected. The investment projects that are being undertaken do not cover their cost of capital and do not enhance either earnings or value for investors. There is, of course, a substantial theoretical literature which suggests that managers may undertake investments for reasons other than the

benefit to shareholders (e.g., Jensen, 1986; Andrikopoulos, 2009). Managerial hubris and empire building may undoubtedly be a problem, and part of the explanation of our results²⁶. However, if this was the whole story, and there was no link at all between investment decisions and shareholder interests, we would suggest it must be questionable whether the present system of corporate governance could have survived²⁷.

There is another possibility consistent with our findings. Growth opportunities measures may successfully identify companies with profitable investment opportunities; those investments may be undertaken; but the EPS of the company overall does not rise because the earnings generated by the new investments are cancelled out by falling earnings on the company's old assets. To fit our empirical findings, the companies with the strongest growth opportunities would also have to be the companies whose earnings from existing assets was going to fall most steeply.

Is such a model plausible? We would argue that it is. In fact, it is exactly what we should expect in competitive markets where changes in demand are stochastic, new capacity takes time to come on stream, and profits are determined by the level of demand in relation to capacity. When demand is high in relation to production capacity, profitability will be abnormally high, and it will be profitable to embark on an investment programme to expand capacity.

As capacity is expanded to meet demand, profitability for the company (and the industry) will fall to normal levels. The studies of Fama and French (2000 and 2007a and b) and Allen and Salim (2005) have demonstrated the tendency of profit levels to revert to the mean. Fama and French (2007a) argue that "Competition from other companies ... tends to erode the high profitability of growth stock companies, and profitability also declines as those companies exercise their most profitable growth

options. Thus, each year, some growth stocks cease to be highly profitable, fast-growing companies...”. (p. 48). If growth/investment opportunities are viewed in this context, the relationship between growth opportunities and future earnings growth becomes unpredictable. While the growth in equity and total assets may be the result of positive NPV investment, the profits gained on the new investment may or may not exceed the reduction in profit on the original assets. We have no way to predict whether the total earnings of companies with growth opportunities will rise or fall.

While Fama and French argue that “...convergence in the profitability, growth, and expected returns of value and growth stocks is anticipated and thus built into the forward-looking prices of stocks” (2007b, p. 53), they acknowledge the alternative argument put forward by Lakonishok *et al.* (1994), who argue that “While the market correctly anticipated higher growth rates in the very short-term, the persistence of these higher growth rates seems to have been grossly overestimated. ...[The results] are consistent with the idea that the market was too optimistic about the future growth of glamour firms relative to value firms” (p. 1562).

Our results, as reported in Table 7 (with significant coefficients on ΔEPS_0 in all regressions) suggests there is significant persistence in earnings growth rates in the UK, whether we are looking at 3, 5 or 10 year horizons. Earnings persistence may therefore be higher for the UK than what was found for the US by Lakonishok *et al.* However, we find no evidence of superior future earnings growth for companies identified as ‘growth companies’ based on either measures or proxies for the level of growth opportunities. Whether the failure of ‘growth companies’ to deliver superior future earnings growth is attributable to competitive forces, poor investments or behavioural biases, the empirical evidence for the phenomenon is strong. While growth

opportunities measures and proxies, in particular the dividend-based measures of DY and HDJ, are successful in identifying companies which will make future investments and thus grow their sales, equity and assets, none of the measures or proxies are successful in predicting future earnings growth. The growth companies puzzle remains.

12. Conclusion

This paper has assessed the ability of eight different growth opportunity measures to predict subsequent firm growth. The use of growth *models*, in addition to growth *proxies*, adds to the findings of the current literature.

The first part of the paper looks at the ability to predict earnings growth, the type of growth that theory suggests is most directly associated with growth companies and which is most directly linked to shareholder value. Using UK data drawn from all companies in the Financial Times All Share Index over the 15 year period 1990 – 2004 inclusive, we test the ability of the eight growth opportunities measures to predict company growth in sales, assets, equity and earnings. Growth opportunities measures do succeed in predicting growth in sales, assets and equity, although some measures perform notably better than others. In general, the more complex models for estimating the level of growth opportunities perform no better than the simpler proxies. Tobin's Q performs poorly, while the two dividend-based measures perform best.

This paper confirms Kallapur and Trombley's (1999) findings that growth opportunities are related to future growth in sales and the book value of equity. However, we have argued that earnings growth is the clearest evidence that profitable growth opportunities are being accepted, and the results for earnings growth are very different. We find that none of the measures is successful in predicting earnings

growth. Indeed, even when taking into account mean reversion and other firm characteristics which have a significant impact on future earnings changes, growth opportunities remain unable to help predict earnings growth. We term this finding the ‘growth companies puzzle’. We argue that the ‘puzzle’ is a genuine finding, not a statistical aberration or the product of measurement errors, and that it needs explanation. Our finding here builds on the work of Lakonishok *et al.* (1994), which suggests that ‘growth’ companies (identified by proxies) do not generate higher earnings growth than ‘value’ companies. This paper extends the analysis to growth models and to UK data.

The paper suggests three possible explanations for these apparently conflicting results. First, if managers suffer from hubris or empire-building tendencies, they may pursue growth in company size rather than earnings, and accept negative NPV projects (e.g., Andrikopoulos, 2009). However, we would suggest it is doubtful whether the present system of corporate governance could have survived if there was no link at all between investment decisions and shareholder interests.

Second, if higher profitability in a competitive market is associated with a shortage of production capacity, then investment in new capacity will have a positive NPV and will grow the scale of the firm, but will also tend to reduce the profit associated with existing capacity. For growth companies the net effect on a company’s EPS becomes unpredictable. Studies which show strong patterns of mean-reversion (e.g., Fama and French, 2007a and b) in company earnings would be consistent with this explanation.

An alternative explanation is offered by behaviourists, such as Lakonishok *et al.* (1994), who suggest investors tend to forecast earnings growth based on extrapolation, and these forecasts are overoptimistic in predicting that rapid growth will continue in

the longer term. While we find evidence of significant earnings growth persistence in the UK, we find no evidence of superior earnings growth for 'growth companies'. Note, however, that the evidence cannot purely be explained by investor bias. The management of growth companies is responsible for the observed increases in assets, sales and equity. Whether the failure of 'growth companies' to deliver superior earnings growth is attributable to increased competition, poor investments, or behavioural biases, it is still a puzzle why growth companies on average fail to deliver superior earnings growth. While all the various growth opportunities measures and proxies tested, particularly the dividend-based measures (Dividend Yield, and the Hirst-Danbolt-Jones model), is significantly related to future firm growth, none of the measures or proxies studied are successful in predicting future earnings growth. The growth companies puzzle remains.

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Table 1. Sample

	KBM	KBM _{real}	HDJ	EVF	EVE	Q	EP	DP
<i>Initial sample</i>	6,163							
<i>Missing data:</i>								
EPS forecast missing, negative or zero	-1,012	-1,012						
EPS ₀ missing							-1,017	
Beta missing	-712	-712	-1,042					
Dividend missing or zero			-594					-854
Book value of equity missing or negative			-110	-205	-205	-205		
Price below book value			-648					
Book value of debt missing				-53				
Total Assets missing						-88		
	4,439	4,439	3,769	5,905	5,958	5,870	5,146	5,309
<i>Outliers</i>								
Trim top and bottom 2.5%	-221	-221	-189	-295	-297	-293	-152	-266
Estimated HDJ P _g negative			-1,065					
Maximum sample for growth proxies	4,218	4,218	2,515	5,610	5,661	5,577	4,994	5,043
Balanced sample	1,942							

The table contains information on the sample construction. We start with an initial sample of 6,163 firm-years for UK Financial Times All-Share constituent firms over the period from 1 January 1990 to 31 December 2004 with sufficient data for the calculation of at least one of the growth opportunities proxies applied in this study. The variables are various measures or proxies for the level of growth opportunities, as specified in equations 5 to 12 in the text, with KBM referring to the level of growth opportunities as measured using the Kester-Brealey-Myers model (with a nominal cost of capital); KBM_{real} to the Kester-Brealey-Myers model with a real cost of capital; HDJ to the Hirst-Danbolt-Jones model for measuring growth opportunities based on dividends; EVF to the Excess Value of the Firm, or the extent to which the market-to-book value of total assets exceed 1; EVE to the Excess Value of Equity, or the extent to which the market-to-book value of equity exceed 1; Q to a modified Tobin's Q based on the market-to-book ratio, EP to the percentage Earnings yield; and DP to the percentage Dividend yield. Where observations fail several data requirements, they are only recorded under "missing data" once, based on the first item of missing data.

Table 2. The Level of Growth Opportunities

	N	Mean	Median	Std.	Min.	Max.	Q1	Q3
<i>Measures of growth opportunities</i>								
KBM	1,942	38.44	42.49	26.05	-84.34	98.82	26.03	55.68
KBM _{real}	1,942	11.55	16.76	38.11	-146.06	98.30	-7.56	37.11
HDJ	1,942	30.09	27.48	20.20	0.02	80.28	12.81	44.33
EVF	1,942	60.16	61.91	19.12	4.91	94.85	47.45	74.78
EVE	1,942	71.18	73.10	16.45	12.33	97.71	60.41	84.26
<i>Growth proxies</i>								
Q	1,942	2.03	1.82	0.82	1.02	5.96	1.48	2.31
EP	1,942	6.85	6.44	3.36	0.07	22.58	4.82	8.16
DP	1,942	2.93	2.85	1.20	0.56	7.39	2.08	3.68
The variables are as defined in Table 1.								

Table 3. Correlation Matrix for Measures of Growth Opportunities and Growth Proxies

	KBM	KBM _{real}	HDJ	EVF	EVE	Q	EP
KBM							
KBM _{real}	0.977***						
HDJ	0.294***	0.284***					
EVF	0.140***	0.100***	0.661***				
EVE	0.089***	0.056**	0.778***	0.806***			
Q	0.233***	0.233***	0.576***	0.721***	0.555***		
EP	-0.545***	-0.556***	-0.201***	-0.097***	-0.043*	-0.237***	
DP	-0.192***	-0.201***	-0.551***	-0.081***	-0.008	-0.239***	0.293***

The table contains the Pearson correlation coefficients between the various measures of growth opportunities and growth proxies. The variables are as defined in Table 1. *, **, and *** indicate that the coefficients are significant at the 10%, 5% or the 1% level, respectively.

Table 4. Realised Future Growth

	N	Mean	Median	Std.	Min.	Max.	Q1	Q3
<i>Sales Growth</i>								
Sales Grow ₊₂₊₄	1,641	0.4616	0.3437	0.5109	-0.3712	3.2153	0.1469	0.6174
Sales Grow ₊₄₊₆	1,370	0.8436	0.5938	0.9648	-0.5227	6.2434	0.2363	1.1377
Sales Grow ₊₂₊₁₁	666	1.3104	0.8473	1.4993	-0.4103	9.5441	0.3550	1.7498
<i>Total Assets Growth</i>								
TA Grow ₊₂₊₄	1,644	0.5516	0.3971	0.6286	-0.4154	3.8491	0.1671	0.7105
TA Grow ₊₄₊₆	1,377	1.0694	0.7034	1.3198	-0.5159	8.6020	0.3135	1.3426
TA Grow ₊₂₊₁₁	670	1.6795	1.0155	2.1260	-0.3887	12.1773	0.4387	1.9399
<i>Equity Growth</i>								
EQ Grow ₊₂₊₄	1,597	0.5462	0.3810	0.6981	-0.5189	4.5510	0.1458	0.7009
EQ Grow ₊₄₊₆	1,335	1.0250	0.6504	1.3495	-0.6206	9.0026	0.2307	1.2695
EQ Grow ₊₂₊₁₁	636	1.5318	0.9221	1.9483	-0.3249	12.3934	0.3997	1.9251
<i>Earnings Growth</i>								
EPS Grow ₊₂₊₄	1,631	0.0118	0.0098	0.0550	-0.2434	0.2374	-0.0063	0.0338
EPS Grow ₊₄₊₆	1,352	0.0150	0.0118	0.0759	-0.3211	0.3918	-0.0170	0.0466
EPS Grow ₊₂₊₁₁	665	0.0227	0.0113	0.0672	-0.2319	0.3854	-0.0092	0.0460

Sales growth, total asset growth, and equity growth, are as defined in equations 18-20, while earnings growth is calculated as specified in equation 17.

Table 5. Correlation Coefficients Between Various Measures of Future Growth

	Sales Growth	Total Asset Growth	Equity Growth
<i>Grow</i> ₊₂₊₄			
Total Asset Growth	0.744***		
Equity Growth	0.576***	0.739***	
Earnings Growth	0.206***	0.175***	0.177***
<i>Grow</i> ₊₄₊₆			
Total Asset Growth	0.788***		
Equity Growth	0.619***	0.765***	
Earnings Growth	0.222***	0.180***	0.175***
<i>Grow</i> ₊₂₊₁₁			
Total Asset Growth	0.823***		
Equity Growth	0.651***	0.871***	
Earnings Growth	0.277***	0.256***	0.218***
The table contains the Pearson correlation coefficients between the various measures of realised future firm growth. *, **, and *** indicate that the coefficients are significant at the 10%, 5% or the 1% level, respectively.			

Table 6. Growth Opportunities and Realised Future Growth

	Predicted sign	Grow ₊₂₊₄	Grow ₊₄₊₆	Grow ₊₂₊₁₁
<i>Sales Growth</i>				
Sample		1,641	1,370	666
KBM	+	0.116***	0.152***	0.150***
KBM _{real}	+	0.113***	0.143***	0.135***
HDJ	+	0.144***	0.139***	0.236***
EVF	+	0.039	0.042	0.086**
EVE	+	0.038	0.048*	0.089**
Q	+	0.046*	0.022	0.052
EP	-	-0.041	-0.078***	-0.126***
DP	-	-0.180***	-0.158***	-0.264***
<i>Total Assets Growth</i>				
Sample		1,644	1,377	670
KBM	+	0.128***	0.129***	0.090**
KBM _{real}	+	0.129***	0.126***	0.081**
HDJ	+	0.148***	0.177***	0.204***
EVF	+	0.057**	0.083***	0.110***
EVE	+	0.066***	0.098***	0.123***
Q	+	0.080***	0.095**	0.098**
EP	-	-0.087***	-0.099***	-0.124***
DP	-	-0.157***	-0.146***	-0.174***
<i>Equity Growth</i>				
Sample		1,597	1,335	636
KBM	+	0.040	0.073***	0.054
KBM _{real}	+	0.042*	0.072***	0.035
HDJ	+	0.217***	0.203***	0.197***
EVF	+	0.122***	0.105**	0.064
EVE	+	0.161***	0.163***	0.151***
Q	+	0.061**	0.066**	0.032
EP	-	-0.005	-0.060**	-0.102***
DP	-	-0.125***	-0.104***	-0.125***
<i>Earnings Growth</i>				
Sample		1,631	1,352	665
KBM	+	0.030	0.043	0.054
KBM _{real}	+	0.040	0.039	0.058
HDJ	+	-0.014	-0.069**	-0.070*
EVF	+	0.015	-0.000	-0.051
EVE	+	-0.033	-0.074***	-0.151***
Q	+	0.030	-0.001	0.004
EP	-	-0.015	-0.022	-0.082**
DP	-	-0.008	0.025	-0.105***

The table contains Pearson correlation coefficients between realised firm growth and various measures and proxies for the level of growth opportunities. *, **, and *** indicate that the coefficients are significant at the 10%, 5% or the 1% level, respectively. Cells which are shaded indicate that the coefficient is significant and of the predicted sign.

Table 7. Determinants of Future Earnings Growth

	Sample	Const.	GO ₀	ROE ₋₁	ΔEPS ₀	ΔDIV ₀ *DPC ₀	ΔDIV ₀ *DNC ₀	ΔTA ₀	lnMV ₀	Adj R ²	F-stat
<i>EPS Grow₊₂₊₄</i>											
KBM	1,392	0.0252***	0.0001	-0.0111	0.3443***	-0.0058	0.0070	-0.0114	-0.0024***	7.6%	17.43***
KBM _{real}	1,392	0.0271***	0.0000	-0.0113	0.3436***	-0.0058	0.0072	-0.0115	-0.0024***	7.6%	17.44***
HDJ	1,392	0.0274***	0.0000	-0.0129	0.3419***	-0.0068	0.0065	-0.0112	-0.0023***	7.6%	17.25***
EVF	1,392	0.0231***	0.0001	-0.0148	0.3381***	-0.0074	0.0060	-0.0106	-0.0022***	7.6%	17.38***
EVE	1,392	0.0253***	0.0000	-0.0133	0.3415***	-0.0070	0.0063	-0.0112	-0.0023***	7.6%	17.28***
Q	1,392	0.0260***	0.0008	-0.0142	0.3387***	-0.0072	0.0067	-0.0109	-0.0023***	7.6%	17.28***
EP	1,392	0.0332***	-0.0009**	-0.0090	0.3627***	-0.0067	0.0079	-0.0118	-0.0024***	7.8%	17.91***
DP	1,392	0.0229***	0.0013	-0.0138	0.3402***	-0.0043	0.0026	-0.0095	-0.0023***	7.6%	17.43***
<i>EPS Grow₊₄₊₆</i>											
KBM	1,152	0.0591***	0.0001	-0.0083	0.3660***	-0.0318*	0.0204	-0.0334***	-0.0068***	6.1%	11.64***
KBM _{real}	1,152	0.0614***	0.0000	-0.0088	0.3649***	-0.0318*	0.0205	-0.0335***	-0.0069***	6.1%	11.62***
HDJ	1,152	0.0660***	-0.0002*	-0.0110	0.3620***	-0.0249	0.0141	-0.0313**	-0.0066***	6.3%	12.10***
EVF	1,152	0.0669***	-0.0001	-0.0085	0.3679***	-0.0310	0.0202	-0.0340***	-0.0070***	6.1%	11.63***
EVE	1,152	0.0777***	-0.0002*	-0.0086	0.3648***	-0.0286	0.0196	-0.0331***	-0.0067***	6.3%	12.02***
Q	1,152	0.0665***	-0.0026	-0.0061	0.3749***	-0.0299	0.0189	-0.0343***	-0.0068***	6.1%	11.70***
EP	1,152	0.0670***	-0.0009	-0.0066	0.3825***	-0.0329*	0.0206	-0.0340***	-0.0068***	6.2%	11.79***
DP	1,152	0.0533***	0.0025	-0.0115	0.3629***	-0.0272	0.0124	-0.0303**	-0.0067***	6.2%	11.82***
<i>EPS Grow₊₂₊₁₁</i>											
KBM	560	0.0754***	-0.0000	-0.0201	0.3357***	0.0129	-0.0276	0.0016	-0.0093***	8.1%	8.00***
KBM _{real}	560	0.0743***	0.0000	-0.0198	0.3351***	0.0136	-0.0267	0.0014	-0.0092***	8.1%	8.00***
HDJ	560	0.0862***	-0.0004***	-0.0254	0.3423***	0.0304	-0.0336	0.0097	-0.0091***	9.7%	9.59***
EVF	560	0.1056***	-0.0004***	-0.0148	0.3611***	0.0185	-0.0149	0.0017	-0.0100***	9.5%	9.38***
EVE	560	0.1325***	-0.0008***	-0.0248	0.3407***	0.0267	-0.0189	0.0102	-0.0094***	11.5%	11.40***
Q	560	0.0881***	-0.0072*	-0.0114	0.3788***	0.0187	-0.0241	-0.0004	-0.0094***	8.6%	8.52***
EP	560	0.0826***	-0.0015*	-0.0137	0.3582***	0.0144	-0.0265	0.0018	-0.0090***	8.5%	8.44***
DP	560	0.0817***	-0.0020	-0.0185	0.3329***	0.0082	-0.0227	-0.0001	-0.0092***	8.2%	8.11***

The table contains regression output from analysis of the relationship between various firm characteristics and future growth in earnings per share. The regression equation is as specified in equation 21. GO refers to the level of growth opportunities, ROE to the return on equity, Δ EPS to the change in earnings per share, Δ DIV*DPC to the change in dividends times a positive dividend change dummy, DNC to a negative dividend change dummy, Δ TA to the change in total assets, and \ln MV to the natural log of the firm market value. *, **, and *** indicate that the coefficients are significant at the 10%, 5% or the 1% level, respectively. Cells which are shaded indicate that the coefficient is significant and of the predicted sign.

Notes

¹ Agency theory suggests investments in negative NPV projects may be undertaken by managers if there is a separation between ownership and control (e.g., Jensen (1986), Carroll and Griffith (2001), and Andrikopoulos (2009)).

² Notable studies using market-to-book ratio measures as proxies for the level of growth opportunities include Collins and Kothari, 1989; Chung and Charoenwong, 1991; Smith and Watts, 1992; Gaver and Gaver, 1993; Kallapur and Trombley, 1999; Jacquier *et al.*, 2001; Burton, 2003; and Adam and Goyal, 2008.

³ See e.g., Kester, 1984; Chung and Chareonwong, 1991; Penman, 1996; Jacquier *et al.*, 2001; and Kallapur and Trombley, 1999.

⁴ See e.g., Rozeff, 1982; Gaver and Gaver, 1993; Smith and Watts, 1992; Kallapur and Trombley, 1999; and Jacquier *et al.*, 2001.

⁵ We have not included a number of other variables which make more fleeting appearances in the literature, such as gearing, R&D and share price volatility.

⁶ While the model was included in the 1st edition (1981) of the Brealey and Myers textbook, the model was more fully discussed and given more prominence from the 4th edition (1991) onwards.

⁷ K_s is estimated using the capital asset pricing model: $K_s = K_f + \beta_s(K_m - K_f)$, where K_f refers to the risk free interest rate and K_m to the return in the stock market index. In the calculations that follow we use β estimates obtained from the London Business School Risk Measurement Service, edited by Dimson and Marsh. We follow Hirst *et al* (2008) and assume an equity risk premium of 6%, which is towards the middle of the estimates put forward in the literature (Dimson *et al.*, 2003). However, as argued by Fama and French (1997, p. 178), “Estimates of the cost of equity are distressingly imprecise. Standard errors of more than 3.0% per year are typical when we use the CAPM or the three-factor model to estimate industry CE’s [cost of equity]”. The costs of capital used in our estimates are similarly subject to considerable measurement error. As the cost of capital will impact on the estimated value of P_a and P_g (see Danbolt *et al.*, 2002), the value of growth opportunities reported should be taken as estimates. However, changing the cost of capital is unlikely to have a significant impact on the relative importance in the value of growth opportunities to the various sample firms, or to the correlation and regression results reported below.

⁸ We use the average of the consensus I/B/E/S earnings forecast, at the financial year end, of current year earnings (F1MN) and earnings for the following year (F2MN), obtained from Datastream.

⁹ K_{sr} is estimated using a real risk free rate in the capital asset pricing model, as follows: $K_{sr} = K_{fr} + \beta_s(K_m - K_f)$. We use the yield on index linked Gilts as the real risk free rate.

¹⁰ The latest edition of the Brealey and Myers text (Brealey *et al.*, 2006) includes an example in which the calculated value of growth opportunities is negative. They note the difficulty of interpreting this result.

¹¹ The KBM model estimate the value of assets in place based on K_s (using the overall equity beta, β_s) rather than the cost of capital for assets in place, K_a (using the beta for assets in place, β_a).

¹² D_0 refers to the dividend for the year, g to the (real) constant rate of growth, and E to the book value of equity per share. Note that the HDJ model discounts using the real cost of capital (K_{ar}), as in KBM_{real} .

¹³ In their study of the dividend behaviour of UK listed companies over the 1990s, Renneboog and Trojanovski (2005) found 85% of the firms to pay dividends, with dividend yields averaging 3.1%.

¹⁴ BV debt is calculated as the sum of book values of loans and short-term debt.

¹⁵ We base the analysis on EP rather than the inverse PE ratio to reduce the influence of outliers when EPS is small.

¹⁶ In the EP model, we use EPS_0 and restrict the analysis to where EPS_0 is positive.

¹⁷ The subsequent analysis of future earnings growth is based on EPS data for the period from January 1989 to December 2007.

¹⁸ There is overall relatively little difference in the correlations whether we base the analysis on Pearson or Spearman (rank) correlations. We therefore simply report and discuss the Pearson correlations.

¹⁹ Data from Thomson ONE Banker database suggests 30% of the acquisitions by listed UK companies during our sample period involved payment in shares, and – as the share financed transactions tended to be larger – ordinary shares accounted for almost 50% of the total consideration paid in these acquisitions.

²⁰ In addition to the 3.3% of the initial sample with negative book values (Table 1), a large proportion of our sample firms have small book values. While Nissim and Ziv (2001) find only 0.6% of their

sample of US dividend-paying companies to have book values of less than 10% of their total assets, the comparable figure for our final sample is 14.3%.

²¹ In our analysis of equity growth, we include all firm-years with positive book values. We have also undertaken the analysis (i) with the sample restricted to cases where book equity accounts for at least 10% of total assets, and (ii) resetting book to 10% of total assets where book values are below this threshold. The results are overall very similar and our conclusions unaffected.

²² Earnings growth measures are only calculated if data is available for each firm year in that earnings measure. Thus, for EPS Grow_{+2+4} , EPS data must be available for years -1, 1, 2, 3 and 4. However, in order to reduce survivorship bias, we do not require data to be available for all growth measures. In the calculations that follow, we use the earnings per share measure WC05201 (obtained from *Datastream*), which include negative earnings. (Note the Datastream variable 'EPS' gives a value of zero for loss-making firms, and is as such not suitable for our analyses).

²³ As a robustness test, we have also undertaken the analysis based on *excess* earnings growth, where we control for general movements in average earnings over our sample period by subtracting the average earnings growth for UK companies during the period of analysis from the measured level of firm growth. The results regarding the relationship between growth opportunities and *excess* earnings growth are very similar to those for earnings growth. For brevity, we do therefore not report the full *excess* earnings results.

²⁴ The results for realised *excess* earnings growth are very similar to those reported above for earnings growth. Over the short period, Q is significant at the 10% level. However, no other purported growth measure is significant at any level. Over the medium term, only HDJ and EVE are significant (at the 5% level), but the relationship has the wrong sign. For our long period, HDJ and EVE still show up as significant but with the wrong sign, while only DP manages to be both significant (at the 5% level) and to have the right sign. Generally the growth opportunity measures perform no better as a predictor of excess earnings growth than they did for unadjusted earnings growth.

²⁵ Analysis of the correlation matrix reveals that ROE_{-1} is significantly negatively related to future earnings growth on a univariate basis, but the variable loses significance in the regression model once we also include ΔEPS . (The correlation between ROE_{-1} and ΔEPS is -0.276, significant at the 1% level). All other correlations are consistent with the regression coefficients reported in Table 7. None of the correlations between the independent variables in Table 7 exceed 0.4, and similarly none of the variance inflation factors (VIF scores) for Table 7 exceeds 1.4. This suggests there is no significant issue of multicollinearity in the analysis. For brevity, we do not report the full correlation matrix, but it is available from the authors upon request.

²⁶ In an empirical study of seasoned equity offers (SEO) in the UK, Andrikopoulos (2009) find issuers generate high turnover at the expense of profitability for the first two years following the equity offers, and that sales revenue also slows down approximately three years after the issue. Andrikopoulos "...suggests that the deterioration in the operating performance is caused by the potential existence of managerial hubris and 'empire-building' biases on behalf of the issuers". (p. 190).

²⁷ We acknowledge, however, that with information asymmetry, it may be difficult for investors to observe the link between marginal investment and marginal earnings.